Syllabus for PTYS/GEOS 554: Evolution of Planetary Surfaces (3 Credits)

The University of Arizona – Fall 2025

Kuiper Space Sciences Building, Room 312, Tuesdays and Thursdays from 2:00 to 3:15 p.m.

Description of Course:

This graduate-level class explores the evolution of planetary surfaces through a variety of geologic processes and how they have shaped planetary landscapes, environments, and exploration priorities. Students will develop a quantitative understanding of the major geophysical and geochemical processes associated with evolution of planetary surfaces within our Solar System and beyond. Students will also develop their scientific reasoning, writing, and communication skills through modeling activities, reports, and presentations. Graduate students will engage with current research questions in planetary surface evolution and develop expertise in critical analysis of peer-reviewed literature.

Course Prerequisites or Co-requisites:

Undergraduate degree in geology, planetary sciences, physics, chemistry, or related field. Graduate standing required. Students should have completed coursework in calculus, physics, and introductory geology or planetary science. Students are also expected to conduct weekly readings and develop written assignments at the graduate level. Please speak to the instructor if you have any questions or concerns about prerequisites.

Instructor, Instructor Contact Information, and Office Hours:

Christopher Hamilton, Phone: +1-301-305-3818, Email address: chamilton@arizona.edu, Zoom (Private Meeting Room): https://arizona.zoom.us/j/3274729158

I will be available in my office (Kuiper Space Sciences Building, Room 430) on Tuesday and Thursday afternoons after class from 3:15 to 4:15 p.m. If you would like to schedule a meeting outside these hours, please contact me via email to arrange a time.

Course Format and Teaching Methods:

The format of the course includes in-class lectures, individual assignments, group assignments, and examinations. Weekly reading assignments drawn from both the course textbook and current peer-reviewed literature. Graduate students will be expected to engage in critical discussions of current research and methodologies in planetary surface evolution.

Course Objectives:

Each week, students will read material from the course textbook and read current peer-reviewed scientific papers. Students are expected to attend lectures and complete homework assignments on time. Graduate students will explore fundamental research questions and develop expertise in

evaluating scientific literature. Students will demonstrate mastery through comprehensive examinations that integrate knowledge across multiple planetary surface processes. Together these activities provide students with a fundamental understanding of geological and geophysical processes as well as develop advanced skills related to critical thinking and scientific analysis.

Expected Learning Outcomes:

Students will learn the geophysical and geochemical basis of the fundamental geological processes that affect planetary surface evolution throughout the Solar System and beyond. Students will also learn quantitative skills that will enable them to calculate how planetary parameters (e.g., gravitational acceleration, ambient temperature and pressure, atmospheric composition) affect fundamental geological processes and resulting landforms. Students will learn how to undertake advanced scientific research by reading and critically analyzing a minimum of fifteen peer-reviewed publications. Students will demonstrate mastery of course material through comprehensive examinations that require synthesis and application of concepts. Students will also develop their scientific writing, modeling, and communication skills through assignments and presentations. As a graduate-level course, students will learn how to critically evaluate current research methodologies and assess the state of knowledge in planetary surface evolution.

Makeup Policy for Students Who Register Late:

Students who register after the first-class meeting may make up missed assignments by Friday, September 5, 2025, without penalty. After this time late assignments will not be accepted.

Course Communications:

Course communication will be conducted via D2L to and from official University of Arizona Email addresses: https://d2l.arizona.edu/

Required Texts and Readings:

The course textbook is available through the University of Arizona bookstore as well as through The University of Arizona Libraries in both hardcopy and electronic formats. PDF copies of the required reading for the first two-weeks of class are available through the course website on D2L, but after the first two-weeks students will be responsible for obtaining the reading material themselves. Other reading material can be accessed via the Internet or The University of Arizona Campus Libraries. The textbook is the following:

Melosh, H. J. (2011) "Planetary Surface Processes", Cambridge University Press, New York, 500 pp.

Additional graduate-level readings will be assigned from current peer-reviewed literature in planetary sciences, geology, and related fields.

Required or Special Materials:

No special tools are required for this class; however, it is assumed that students have access to a basic computer, software (e.g., Microsoft Office, which is freely available through The University of Arizona), and internet connectivity to access electronic documents (e.g., the eBook textbook), prepare and submit assignments, and access other on-line content via D2L. Graduate students may need access to specialized software for data analysis and modeling exercises.

Required Extracurricular Activities:

No extracurricular activates or field trips are planned. Project groups are encouraged to work together outside of class, but in-class opportunities for team project development are provided.

Assignments and Examinations:

Leading up to the Mid-Term Examination (October 28), students will read a chapter from the textbook and submit a report via D2L. A tenth READING report will be due on November 20, connecting textbook subjects to the Planetary Science and Astrobiology Decadal Survey 2023–2032. Students may be asked to present their reports to the class. Team presentations will be on November 6 and December 8. The Final Examination will be held in-class (December 10).

Final Examination

The Mid-Term Examination (October 28) tests textbook and lecture comprehension. The Final Examination (December 10) tests contextual understanding of Planetary Surface Processes.

Grading Scale and Policies:

The course employs The University of Arizona's standard grade system (i.e., A, B, C, D, and E). For additional information regarding the university's policy regarding grades and grading systems see: http://catalog.arizona.edu/policy/grades-and-grading-system

Homework Assignments: 10 × 4% = 40%; Group Assignments: 2 × 10% = 20%; Mid-Term Examination: 1 × 20% = 20%; Final Examination: 1 × 20% = 20%

Grading: All final grades will be rounded up to the nearest whole percentage point and percentage grades will be converted to letter grades as follows:

≥90% ⟶ A, ≥80% (<90%) ⟶ B, ≥70% (<80%) ⟶ C, ≥60% (<70%) ⟶ D, <60% ⟶ E

Incomplete (I) or Withdrawal (W):

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal, respectively.

Dispute of Grade Policy:

If an error has been made with a grade, please address the issue with the instructor within one week of the grade being posted on D2L. At the end of the semester, final grades will be rounded up to the nearest percentage point. Grades will not otherwise be scaled or modified. Nonetheless, mistakes do happen, and it is reasonable and appropriate to challenge a grading mistake on an exam or assignment, or to request clarification about any grade. However, please do so in a timely fashion, and not wait until the end of the semester.

Scheduled Topics/Activities:

Table 1 summarizes the topics and baseline reading assignments for the semester. Additional reading assignments may be added (see notices on D2L). It is expected that students will read assigned textbook chapters before the related lecture and submit an associated report via D2L on each Thursday. Upload folders will be closed once class starts and late assignments will only be accepted with the instructor's consent. Unless prior arrangements are made, late assignments will receive a 20% penalty each day the assignment is late, including the first day they are due. Instructions for the weekly assignments and term paper are available on D2L and will be reviewed in class.

Week	Tuesday	Thursday
1	**Aug. 26:** Syllabus review and discussion of individual assignments, group projects, and the use of AI in this course and academic research in general.	**Aug. 28:** Introduction to Planetary Surface Evolution. *Reading:* "Planetary Surface Processes", Chapter 1: The Grand Tour; **Homework Due (Reading Report 1)**
2	**Sept. 2:** Introduction to the Solar System	**Sept. 4:** Introduction to the Solar System; *Reading:* "Planetary Surface Processes", Chapter 3: Strength vs. Gravity; **Homework Due (Reading Report 2)**
3	**Sept. 9:** The Fundamental Properties of Geologic Materials	**Sept. 11:** The Fundamental Properties of Geologic Materials; *Reading:* "Planetary Surface Processes", Chapter 4: Tectonics; **Homework Due (Reading Report 3)**
4	**Sept. 16:** Tectonic Processes	**Sept. 18:** Tectonic Processes; *Reading:* "Planetary Surface Processes", Chapter 9: Wind; **Homework Due (Reading Report 4)**
5	**Sept. 23:** Aeolian Processes	**Sept. 25:** Aeolian Processes; *Reading:* "Planetary Surface Processes", Chapter 5: Volcanism; **Homework Due (Reading Report 5)**
6	**Sept. 30:** Volcanic Processes	**Oct. 2:** Volcanic Processes; *Reading:* "Planetary Surface Processes", Chapter 6: Impact Cratering **Homework Due (Reading Report 6)**

Week	Tuesday	Thursday
7	**Oct. 7:** Impact Cratering Processes	**Oct. 9:** Impact Cratering Processes; *Reading:* "Planetary Surface Processes", Chapter 10: Water **Homework Due (Reading Report 7)**
8	**Oct. 14:** Water	**Oct. 16:** Water; *Reading:* "Planetary Surface Processes", Chapter 11: Ice; **Homework Due (Reading Report 8)**
9	**Oct. 21:** Ice	**Oct. 23:** Ice; *Reading:* "Chapter 17: Regoliths, Weathering, and Surface Texture; **Homework Due (Reading Report 9)**
10	**Oct. 28:** Weathering and Erosion	**Oct. 30: MID-TERM EXAMINATION**
11	**Nov. 4:** Team Project Development	**Nov. 6:** Team Project Presentation
12	**Nov. 11:** NO CLASS – Veterans Day	**Nov. 13:** Deep-Time and Astrobiology; *Reading:* Selections will be posted on D2L
13	**Nov. 18:** Inner Solar System; *Reading:* Selections will be posted on D2L	**Nov. 20:** Outer Solar System; *Reading:* Selections will be posted on D2L; **Homework Due (Reading Report 10 – Decadal Survey)**
14	**Nov. 25:** NASA Decadal Priorities for Solar System Exploration; *Reading:* Selections will be posted on D2L	**Nov. 27:** NO CLASS – Thanksgiving Recess
15	**Dec. 2:** Team Project Development	**Dec. 4:** Team Project Presentation
16	**Dec. 9: FINAL EXAMINATION**	**Dec. 11:** NO CLASS – Reading Day

Classroom Behavior Policy:

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities.

Some learning styles are best served by using personal electronics, such as laptops and iPads. However, these devices can be distracting to other learners. Students who prefer to use electronic devices for note-taking during lecture may do so, but please use your devices responsibly.

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Threatening Behavior Policy:

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See:
http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students

Notification of Objectionable Materials:

This course does not contain material of a mature nature, such as explicit language, depictions of nudity, sexual situations, and/or violence. However, students are encouraged to speak with the instructor to voice concerns and to provide feedback should there be any issues.

Safety on Campus and in the Classroom:

For a list of emergency procedures for all types of incidents, please visit the website of the Critical Incident Response Team (CIRT): https://cirt.arizona.edu/case-emergency/overview

Also watch the video available at:
https://arizona.sabacloud.com/Saba/Web_spf/NA7P1PRD161/common/learningeventdetail/crtfy000000000003560

Confidentiality of Student Records:

See: http://www.registrar.arizona.edu/ferpa

Additional Resources for Students:

UA Academic policies and procedures are available at: http://catalog.arizona.edu/policies

Campus Health http://www.health.arizona.edu Campus Health provides quality medical and mental health care services through virtual and in-person care. Phone: 520-621-9202

Counseling and Psych Services (CAPS) https://health.arizona.edu/counseling-psych-services CAPS provides mental health care, including short-term counseling services. Phone: 520-621-3334

The Dean of Students Office's Student Assistance Program:
https://deanofstudents.arizona.edu/support/student-assistance

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services. Email: DOS-deanofstudents@arizona.edu Phone: 520-621-7057

Survivor Advocacy Program: https://survivoradvocacy.arizona.edu/

The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support. Email: survivoradvocacy@arizona.edu. Phone: 520-621-5767

University-wide Policies:

Links to the following UA policies are provided here: http://catalog.arizona.edu/syllabus-policies. These include:

• Absence and Class Participation Policies
• Threatening Behavior Policy
• Accessibility and Accommodations Policy
• Code of Academic Integrity
• Nondiscrimination and Anti-Harassment Policy
• Subject to Change Statement

Artificial Intelligence:

In this course you are welcome and expected to use generative artificial intelligence (AI)/large language model (LLM) tools (e.g., ChatGPT, Dall-e, Bard, Perplexity). However, use of such tools must be disclosed in your report. Failure to report AI/LLM constitutes plagiarism. Also, be aware that many AI companies collect information; do not enter confidential information as part of a prompt. LLMs may generate false information and tools may reflect misconceptions and biases of the data they were trained on and the human-written prompts used to steer them. You are responsible for checking facts, finding reliable sources for, and making a careful, critical examination of any work that you submit. Nonetheless, use of AI/LLM tools aligns with the course learning goals in that it enables students to learn how to assess AI-generated content. Experimenting with AI/LLM tools also helps students to be aware of their value and limitations.

Health and Attendance

- Preserving your health and the health of others on campus is a priority.

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.

- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.

Land Acknowledgement:

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 Federally-recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities.

Subject to Change Statement:

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.